

# ISEAIA 2015



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## Abstract Proceedings

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**GAU**  
GİRNE AMERICAN  
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Dear ISAIA2015 Participant,

We would like to welcome you to Girne American University.

GAU's goal is to become a University with and without walls, a University located in time and place but unhampered by constraints in the fulfillment of its mission. To do this, GAU maintains constant awareness of the impact of technology and how it changes knowledge and learning. GAU evaluates its courses, and programs to be sure that the curriculum and learning strategies reflect these changes.

Faculty of Engineering and Architecture, which was established in 1992, was separated into two faculties in 2009. Faculty of Engineering started to function from 2009-2010 academic year on. Faculty of Engineering aims to educate fully qualified engineers in all aspects. In today's competitive environment, the engineers who are the graduates of GAU Faculty of Engineering, are aimed to be fully equipped with contemporary engineering skills. The vision of Faculty of Engineering is to become comprehensive, distinct faculty that is recognized both nationally and internationally in engineering teaching, research and development. The mission is to create and disseminate knowledge through creative inquiry, to provide the high standards in engineering education and to serve our students by teaching them how to become contemporary engineers who are culturally informed and well equipped with technological skills. In carrying out its mission, Faculty of Engineering commits to continually evaluating, improving and evolving its programs and stimulates meaningful research and service to community by which they belong to. As a result of the continuous quality improvement studies, Faculty of Engineering was awarded ASIIN Accreditation in December 2012 for Computer, Electrical and Electronics and Industrial Engineering Departments. These three programmes are also awarded by EUR-ACE Labels since June 2014.

Within this context The Third International Symposium on Engineering, Artificial Intelligence and Applications (ISEAIA 2015) is devoted to play a unique role in providing a platform for researchers, practitioners, developers and educators to share their experiences in the fields of engineering, artificial intelligence and their applications in a friendly environment. We will find the opportunity to provide communication among researchers and to encourage multi-disciplinary and inter-disciplinary researches by ISEAIA 2015.

We are proud to inform you that this year our symposium gained more interest by researchers around the world. As part of the symposium, you will be able to attend 47 presentation sessions and 2 keynote addresses.

We sincerely hope you have an outstanding stay in Kyrenia.

With warm regards,

Assoc. Prof. Dr. Zafer Ağdelen

Symposium Chairman  
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**Prof. Dr. Alexander Kostin**

Alexander E. Kostin received his BS degree in electrical engineering from Ryazan Radiotechnical Institute (Technical University), Ryazan, Russia, a PhD in computer engineering from Moscow Engineering-Physical Institute (Technical University), Moscow, and a DSc degree in computer science from Moscow Institute of Electronic Technology (Technical University), Moscow. Up to 1995, he worked as Associate Professor and then as Professor in the Department of Computer Engineering at Moscow Institute of Electronic Technology – Technical University. Since 1995, he has been working as Associate Professor and then Professor in the Department of Computer Engineering of Eastern Mediterranean University, Famagusta, Cyprus. As a university professor, he prepared a variety of courses in computer science

and computer engineering, including "Mathematical Foundations of Cybernetics", "System Simulation", "Systems Programming", "Computer Networks", "Network and Distributed Systems", "Internet Architecture and Protocols". His research and professional interests include computer systems analysis, distributed systems and their modeling and simulation, Petri nets and their extensions, advanced simulation systems. He is an author or co-author of six textbooks for students, of over one hundred of other works, including papers in journals and conference proceedings, and surveys of computer science and computer engineering books in English and German languages. His biographical information is published in Marquis Who's Who in the World, 23rd ed., 2006, and in S.Rains (ed.), "2000 Outstanding Intellectuals of the 21st Century", Ed. 5, Melrose Press, 2009.

### **Extended Petri nets for modeling and simulation of information systems**

There are a number of specific theoretical methods and frameworks available for a formalized description, modeling and investigation of complex information systems. These methods and frameworks include, but are not limited to finite state machines (FSM), queuing networks, the communicating sequential processes (CSP) model, the calculus of communicating systems (CCS), the temporal logic, and Petri nets. An efficient theoretical framework for information systems should have simple means to express different aspects related to the parallelism of events and processes, their synchronization, properties of safety and liveness, and the formal methods to prove these properties. The framework should give the possibility to perform the analysis of reachable states in such systems considered as discrete-event systems. Finally, the required framework must provide a graphical representation and description of system models and their components and be supported by corresponding tools for designers. All these capabilities are available in Petri nets that originally have been proposed by a German scientist Karl Petri in 1962. These nets are considered as general or classical Petri nets. In this presentation, initially general information is given about classical Petri nets. Unfortunately, general Petri nets do not represent a universal algorithmic system and therefore cannot be used for simulation of dynamic systems. The impossibility of the use of general Petri nets for simulation purposes gave rise to the development of their different extensions such as Petri nets with inhibitor arcs, timed Petri nets, stochastic Petri nets, colored Petri nets, predicate/transition Petri nets that allow for both qualitative and quantitative analyses. In this presentation, I will concentrate on a class of extended Petri nets (EPN) that has been developed by our research group in Moscow since 1978, implemented in the form of a few versions of simulation system and used in a number of published papers and MS and PhD theses in Moscow, EMU and GAU. After explanation of the concept of elementary net, the basic set of elementary nets is introduced. This set is sufficient to build models of dynamic systems of any complexity. The use of extended Petri nets is illustrated with a few examples of solved models of queuing systems. A brief information is given about the simulation system Winsim that implements all stages of the development and running of models in terms of extended Petri nets. A reference to our book is given that contains detailed information about extended Petri nets, software of Winsim and numerous examples of solved simulation models.



### **Prof. Dr. Adnan Khashman**

Prof. Dr. Adnan Khashman was born in Amman, Jordan, where he completed his elementary and secondary education in the military college of King Faisal II. He then moved to England and studied his GCE A'Levels at Davies's College in Brighton in 1986, and obtained his Bachelor of Engineering (BEng) degree with honors in Electronic & Communications Engineering from the University of Birmingham in 1991. His MSc. and Ph.D. degrees in Electronic Engineering were obtained in 1992 and 1997, respectively, from the University of Nottingham in England. Until 1998 he worked in a private company in London as a software developer. In 1998 he moved to Northern Cyprus to start working with Near East University in Nicosia until 2014. During then, he climbed up the academic ladder from Assistant Professor in 1998 to full Professor

in 2009. He also held several administrative duties including Chairman of the Computer Engineering Department, Chairman of the Electrical and Electronic Engineering Department, Vice-Dean of Engineering Faculty, and finally Dean of Engineering Faculty. He also founded the Intelligent Systems Research Centre at the same university and directed it between 2001-2014. Furthermore, during 2009-2010 he was a Research Fellow at the Hellenic Open University in Patras, Greece. From 2010 till 2013 he was a part-time Professor at the European University of Lefke. Since 2014 he moved to the British University of Nicosia and served as the Vice-Rector and the Founding Dean of Engineering Faculty. Currently, he continues in the British University of Nicosia as the Dean of Engineering Faculty, as well as the Founding Director of the Centre of Innovation for Artificial Intelligence (CiAi). His current research interests include emotion modeling in neural networks and their engineering applications, intelligent systems and their emerging applications, image processing, and pattern recognition. Prof. Dr. Khashman is a Senior Member of IEEE, and a reviewer for many journals. He has authored and co-authored more than 100 scientific publications including 44 SCI-index papers.

### **Artificial Emotions in Machines**

The idea of machines having emotions sounds like science fiction, however, a few decades earlier the idea of machines with intelligence seemed also like fiction, but today we are developing intelligent systems with successful outcomes in various applications. We have always overlooked the emotional factor during machine learning and decision making; perhaps due to our inability to comprehend emotions artificially. However, it is quite conceivable nowadays to artificially model certain emotions and use them to enhance machine learning. In this seminar, a brief review of modeling artificial emotions will be presented. Additionally, our work on "creating" affective machines with emotions including the EmNN, iEmNN, and the DuoNN emotional neural models will be described. This will be followed by a general discussion with the participants on Artificially Emotional & Intelligent Systems.

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# Comparative Study of Universal Function Approximators (neural Network, Fuzzy Logic, Anfis) for Non-linear Systems

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**Keywords:** Function Approximation, Neural Network, Fuzzy Logic, ANFIS, Non-Linear Systems

The Fuzzy Logic, Artificial Neural Networks (ANN) and Adaptive Neuro Fuzzy Inference System (ANFIS) are known as universal function approximators which have been used in many various applications. In general, a function approximator needs to select a function or a mapping algorithm among the well-defined methods that closely capture the input – output variables relation. This study compares the application of aforementioned artificial intelligence approximators by using two non-linear functions. The curve-fitting capability of approximators has been compared as per three main metrics. These metrics are; fitting Root Mean Square Error (RMS), memory occupation, program code size and running time. Additionally, the parameters which effect the performance of each system have been investigated in details. For example; number of fuzzy rules, position and shape of the membership function determines the performance of the fuzzy approximator. Similarly, the performance of ANN is related to number of number of neurons in hidden layer and the number of training samples. In a similiar manner, the efficiency of the ANFIS as a hybrid intelligent system depends on the combination of all the mentioned parameters. The entire analysis has been developed and accomplished by MATLAB.

# Data-driven Modeling of Quadriceps and Hamstring Muscle Strength Using Support Vector Machines

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**Keywords:** Support vector machines, decision tree forest, radial basis function network, muscle strength prediction

Muscular strength refers to the maximal amount of force that a muscle can apply against a resistance in a single effort. The basic purpose of skeletal muscle is the creation of force, either to stabilize and balance the skeleton or to generate movement. Consequently, athletes of various sport branches require high muscular performance to attain success. Two types of upper leg muscles are especially related to the performance of athletes. The quadriceps muscles play an important role in jumping and kicking whilst the hamstring muscles are found to control running activities and stabilize the knee during turns or tackles.

Isokinetic testing is the most popular and common technique for directly measuring the quadriceps and hamstring muscle strength of the upper leg. Isokinetic exercise is usually conducted by using the so-called dynamometers which sustain a constant velocity of movement. Prior to performing the isokinetic exercise, the participant is stationed in such a way that the body movement to be measured is isolated. Afterwards, the dynamometer is adjusted at different velocities and the force exerted by the participant can be measured over the entire range of movement.

Despite a high level of accuracy, the direct measurement of quadriceps and hamstring muscle strength is associated with a number of practical difficulties and limitations. The equipment required for conducting the measurements is bulky, expensive and not readily available. In particular, such measurement activities are frequently conducted within the scope of research projects at educational institutions or provided as services in rehabilitation or health-care facilities. Also, it is only possible to test one participant at a time so that the practical application of direct measurement is not feasible for large populations. On these grounds, researchers have devised alternative ways to predict rather than measuring the quadriceps and

hamstring muscle strength. Although there exists some studies in literature on prediction of the quadriceps and hamstring muscle strength, none of these studies have utilized promising machine learning methods which provide important tools for intelligent data analysis.

The purpose of this study is to build prediction models for estimating the quadriceps and hamstring muscle strength of the upper leg using Support Vector Machine (SVM). The dataset included 70 volunteers who were students at the Department of Physical Education and Sport in Gazi University. Test data were obtained from an Isomed 2000 isokinetic dynamometer. The predictor variables gender, age, height, weight and sport branch were utilized to build the quadriceps and hamstring prediction models for both classic and static training. The generalization error of the prediction models has been calculated by carrying out 10-fold cross-validation, and the prediction errors have been computed using two well-known metrics, namely standard error of estimate (SEE) and multiple correlation coefficient (R). For comparison purposes, prediction models based on Decision Tree Forest (DTF) and Radial Basis Function Network (RBF) have also been developed.

The results have shown that among the machine learning methods, the SVM-based prediction models employing the radial basis function kernel yields the lowest SEE's and the highest R's, independent of whether quadriceps or hamstring muscle strength is predicted; or whether classic or static training has been applied to the participants. In particular, the SVM-based model for prediction of quadriceps muscle strength yields an SEE value of 24.16 W and an R value of 0.89 for classic training; and an SEE of value of 22.40 W and an R value of 0.90 for static training, respectively. Similarly, the SVM-based model for prediction of hamstring muscle strength gives an SEE value of 15.54 W and an R value of 0.90 for classic training; and finally an SEE value of 15.74 W and an R value of 0.90 for static training, respectively.

Furthermore, the following observations could be gained from the results:

- For the DTF-based prediction model, the SEE and R values for prediction of quadriceps muscle strength have been found as 24.87 W and 0.88 for classic training; and 23.08 W and 0.90 for static training, respectively. Similarly, the SEE's and R's for prediction of hamstring muscle strength have been obtained as 16.97 W and 0.88 for classic training; and 16.73 W and 0.88 for static training, respectively.
- The RBF-based prediction model, on the other hand, shows relatively the worst performance in terms of prediction accuracy. In more detail, the SEE's and R's for prediction of quadriceps muscle strength are 26.63 W and 0.87 for classic training; and 26.71 W and 0.86 for static training, respectively. Similarly, the SEE and R values for prediction of hamstring muscle strength have been found as 18.24 W and 0.86 for classic training; and 17.40 W and 0.87 for static training, respectively.
- As compared to the SEE's obtained by DTF-based and RBF-based prediction models, the maximal percentage decrement rates in SEE's obtained by SVM-based prediction models are in average 14.56% and 2.99% for prediction of quadriceps muscle strength, and 7.73% and 13.92% for prediction of hamstring muscle strength, respectively.
- The performance of the prediction models for classic and static training have been found to be comparable to each other, regardless of whether SVM, DTF or RBF have been utilized for model development.

- The execution times of SVM-based prediction models change between 1 and 6 seconds. The RBF-based prediction models have execution times ranging from 8 to 18 seconds. Finally, the DTF-based prediction models have negligible execution times (a few fractions of a second only).
- This is the first study that ever used intelligent regression methods for prediction of quadriceps and hamstring muscle strength of the upper leg. The results of the study reveal that SVM can be employed as a promising and feasible tool for prediction of quadriceps and hamstring strength within limits of acceptable accuracy.

# Artificial Neural Networks for Predicting the Resonant Frequency and Q-factor of Whispering Gallery Mode Cylindrical Dielectric Resonators

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**Keywords:** Neural networks, dielectric resonator, resonant frequency, Q-factor

Dielectric resonators are unmetallized dielectric objects of high quality factor (Q-factor) that can function as energy storage devices. Because dielectric resonators are small, lightweight, temperature-stable and have high Q-factors and low cost, they are ideal for design and fabrication of monolithic microwave integrated circuits and general semiconductor devices. Such technology usually requires high Q-factor miniature elements to design and fabricate highly stable frequency oscillators and high performance narrow band filters.

A new type of dielectric resonators employed at millimeter wave frequencies, called traditionally whispering gallery modes (WGM's), have been popular for quite a while. Dielectric resonators acting on WGM's are very interesting because (a) their dimensions are relatively large, even in the millimeter-wavelength band; (b) their Q-factors are very high; (c) they offer good suppression of spurious modes; and (d) they provide a high level of integration. Although WGM dielectric resonators can take various forms such as spheres, disks and parallelepipeds; cylindrical ones are the most promising structures for measurement applications such as complex permittivity determination of dielectric materials. The design for such resonators requires the accurate computation of the resonant frequency and the Q-factor of the operating mode. Although numerous techniques exist for this purpose, these techniques are usually complex and require the solution of characteristic equations numerically, which is a time consuming process.

The purpose of this study is to develop data-driven models for predicting the resonant frequency and Q-factor of a parallel-plates-type cylindrical dielectric resonator with WGM's using artificial neural networks. Three types of artificial neural networks have been considered including Group Method of Data Handling Polynomial Neural Network (GMDH), Multilayer Perceptron (MLP) and Radial Basis Function Neural Network (RBF). The dataset is comprised of 308 samples and the input variables of the dataset are the mode number in the axial direction, mode number in the radial direction, axial dielectric permittivity, radial dielectric permittivity and dielectric loss tangent. By performing 10-fold cross-validation on the dataset, the accuracy of the prediction models have been tested using the standard error of estimate (SEE) and multiple correlation coefficient (R) metrics.

The results suggest that compared to the MLP-based and RBF-based prediction models; the GMDH-based prediction model shows the best performance (i.e. lowest SEE and highest R), regardless of whether the resonant frequency or Q-factor is predicted. More specifically, the GMDH-based model for prediction of resonant frequency gives the lowest SEE and the highest R with 0.04 Hertz and 0.99; and the GMDH-based model for prediction of Q-factor leads to the lowest SEE and highest R with 8638.96 and 0.58, respectively.

Moreover, the following comments can be made based on the results:

- The SEE and R values of the MLP-based and RBF-based prediction models have been found to be comparable to each other. For the MLP-based model, the lowest SEE and the highest R values have been found as 0.23 Hertz and 0.99 for prediction of resonant frequency; and 10303.80 and 0.26 for prediction of Q-factor, respectively. For the RBF-based model, the lowest SEE and the highest R values have been obtained as 0.15 Hertz and 0.99 for prediction of resonant frequency; and 10319.40 and 0.25 for prediction of Q-factor, respectively.

- Compared to the SEE values of the MLP-based prediction models, the GMDH-based prediction model gives 69.82% lower SEE for prediction of resonant frequency; and 16.28% lower SEE for prediction of Q-factor, respectively. Similarly, compared to the SEE values of the RBF-based prediction models, the SEE values of the GMDH-based prediction models are 79.86% lower for prediction of resonant frequency; and 16.15% lower for prediction of Q-factor, respectively.

- The shortest execution times have been obtained by GMDH-based prediction models which change between 2 and 5 seconds. The execution times of the MLP-based models, on the other hand, vary between 3 and 8 seconds. Finally, the RBF-based prediction models require the longest execution time ranging from 26 seconds up to 3 minutes.

- In summary, it turns out that the GMDH-based prediction models were able to predict the resonant frequency and Q-factor with reasonable errors and can be utilized to quickly produce acceptable predictions.

# Support Vector Machines for Prediction of Endurance Times Involving Isometric Side Bridge Exercise Test

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**Keywords:** Support vector machines, endurance time, prediction

The endurance time provides a convenient means to assess muscle fatigue resistance and is viewed an important component influencing the performance of athletes in various sport branches, such as cycling, rowing, cross-country skiing, swimming and running. Although endurance time can accurately be measured by conducting isometric contraction exercise tests, many individuals are unaccustomed to holding an isometric contraction for an extended period of time, so that the related research community is interested to provide alternative ways to determine the endurance time. One possible way is to collect ratings of perceived exertion (RPE) data during isometric side bridge exercise tests, which is an individual's evaluation of fatigue based on a scale from 0 to 10 that can serve as an indirect predictor of endurance time.

The objective of the study is to combine RPE data and other significant independent variables such as gender and body mass index (BMI), to generate SVM-based regression models that can accurately predict maximal endurance times. For comparison purposes, prediction models based on Radial Basis Function Neural Network (RBF) and Decision Tree Forest (DTF) have also been developed. The dataset created through the execution of the isometric side bridge exercise test included 80 college-aged individuals who are considered healthy and are not experiencing any type of musculoskeletal pain that may influence their ability to do any of the exercise assessments or any musculoskeletal condition. A wide range of participants with varying fitness levels (low fit, average fit, high fit and athletic) have been assessed to make the results more robust and generalizable across college-age individuals. The predictor variables used to develop the prediction models included gender, BMI and the times to reach an RPE value of 4, 5, 6, 7 and 8, which are referred to as RPE-4-time through RPE-8-time, respectively. In total, five different endurance time prediction models have been developed, each of which contains three predictor variables. The common predictor variables appearing in each model are gender and BMI, whereas rest of the predictor variables including RPE-4-time through RPE-8-time have been individually added into the five prediction models, respectively. Three cases regarding the dataset have been considered, with the intention to examine the effects of exclusion of the outlier entries within the dataset. In the first case, the

full dataset has been employed which include all subjects without any exclusion criteria. In the second case, all subjects having an endurance time equal to 300 seconds were removed from the dataset. Finally, in the third case, all subjects having an endurance time equal to 300 seconds and a maximal RPE value below 9 were excluded from the dataset. By performing 10-fold cross-validation on the dataset for each of the three cases separately, the performance of the prediction models has been evaluated by calculating their standard error of estimates (SEE's) and multiple correlation coefficient (R's).

The results suggest that the model containing the predictor variables gender, BMI and RPE-8-time gives the lowest SEE's and the highest R's for prediction of endurance time, regardless of whether SVM, RBF or DTF has been employed for model development or whether the first, second or third case of the dataset has been considered for the evaluation.

In more detail, the results of the study can be summarized as follows:

- Investigation of the three cases of the dataset reveals that the third case, which excludes all outliers of endurance times and RPE values, leads to the lowest SEE's and highest R's; whereas the first case, which considers the full dataset, gives the highest SEE's and lowest R's for prediction of endurance time.
- For the first case of the dataset, the lowest SEE's and the highest R's have been obtained by the SVM-based prediction model including the predictor variables gender, BMI and RPE-8-time with 23.24 s and 0.90, respectively. Building the same prediction model with RBF gives the second most accurate prediction with an SEE value of 24.38 s and R value of 0.94; whereas the development of the model with DTF yields an SEE value of 37.92 s and an R value of 0.75.
- Similarly, for the second case of the dataset, the SVM-based prediction model containing the predictor variables gender, BMI and RPE-8-time gives the lowest SEE and the highest R with 20.72 s and 0.92, respectively. The SEE and R values of the RBF-based prediction model have been found as 21.69 s and 0.91; and the SEE and R values of the DTF-based prediction model have been obtained as 31.68 s and 0.65, respectively.
- Finally, for the third case of the dataset, the SVM-based model comprised of the predictor variables gender, BMI and RPE-8-time leads to the lowest SEE and highest R with 19.91 s and 0.93, respectively. The RBF-based model yields an SEE value of 20.71 s and an R value of 0.92; and finally the DTF-based model gives an SEE value of 31.74 s and an R value of 0.81 for prediction of endurance time.
- The model including the predictor variables age, BMI and RPE-4-time exhibits the worst prediction performance and gives an average SEE value of 52.37 s for SVM; an average SEE value of 55.07 s for RBF; and finally an average SEE value of 57.57 s for DTF for all the three cases of the dataset.
- An increase in the times to reach the values of RPE-4-time through RPE-8-time also decreases the SEE values of related models for prediction of endurance time. Stated in other words, inclusion of RPE-8-time in prediction models has the strongest improving effect in terms of achieved SEE and R values; whereas inclusion of RPE-4-time relatively leads to the highest SEE's and lowest R's.

- The ranking of regression methods in terms of leading from lowest SEE's to highest ones can be listed as SVM, RBF and DTF; irrespective of which case of the dataset has been considered.
- In summary, it has been shown that SVM-based models can accurately predict maximum endurance times from RPE data along with the physiological variables gender and BMI.

# Data-driven Prediction of VO<sub>2</sub>max Based on Maximal and Submaximal Variables Using Support Vector Machines Combined with Feature Selection

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**Keywords:** Support vector machines, feature selection, maximal oxygen uptake

Cardiorespiratory fitness (CRF) describes the ability of performing dynamic, moderate-to-high intensity exercise by utilizing wide muscle groups for extended periods of time. Having a high CRF provides a number of different benefits, such as reducing the risk of heart disease, lung cancer, diabetes and many other diseases; supporting to improve lung and heart condition; and enhancing feelings of wellbeing. A low CRF, in contrast, is associated with a significant increase in risk of premature death from all causes, but especially from cardiovascular disease. Thus, for the individuals it is of significant importance to monitor and improve their CRF through regular exercises.

Standard tests for determining CRF involves directly measuring maximal oxygen uptake (VO<sub>2</sub>max) during maximal graded exercise tests (GXT's) which are usually performed on a treadmill, ergometer or track. However, in spite of high level of accuracy, direct measurement of VO<sub>2</sub>max is related to a number of practical difficulties and limitations. GXT's require trained staff as well as costly laboratory equipment, and are not convenient for some individuals, as the tests are of strenuous nature which in turn could pose a hazard to older or higher risk individuals. Also, GXT's are time-consuming, and not suitable for measuring VO<sub>2</sub>max of large populations outside of the laboratory.

The practical limitations of direct testing have given rise to develop various regression models for predicting VO<sub>2</sub>max rather than measuring it. Within the course of the past decade, numerous VO<sub>2</sub>max prediction models based on maximal, submaximal, questionnaire and combined "hybrid" variables have been proposed in literature. However, to the best of our knowledge, no study has ever attempted to evaluate the mixture of maximal and submaximal variables along with a feature selection algorithm to reveal the discriminative predictors of VO<sub>2</sub>max. The aim of this study is to build various VO<sub>2</sub>max prediction models based on maximal and submaximal variables using Support Vector Machine (SVM) combined with the Relief-F feature selection algorithm. The rationale is to remove the redundant and irrelevant variables from the sets of maximal and submaximal variables, and combine the most relevant variables from each category in a hybrid prediction model to increase the accuracy over a single model. The dataset is comprised of apparently healthy college students from Brigham Young University (115 males and 70 females), ranging in age from 18 to 26 years, who successfully accomplished a submaximal 1.5 mile endurance test and a maximal GXT. The dataset incorporates the physiological variables gender, age, height and weight; the maximal

variables heart rate (MAX-HR) and respiratory exchange ratio (MAX-RER); and finally the submaximal exercise times (SM-MIN1, SM-MIN2 and SM-MIN3) and heart rates (SM-HR1, SM-HR2 and SM-HR3) at the 0.5-mile mark, 1-mile mark and 1.5-mile mark, respectively. By applying the Relief-F feature selection algorithm on the dataset, the ranking (from highest to the lowest score) of the predictor variables have been determined as weight, SM-MIN3, MX-HR, SM-MIN2, height, gender, SM-HR3, SM-MIN1, age, SM-HR2, SM-HR1 and MX-RER. By removing the predictor variable with the lowest score from the full set of predictor variables iteratively, twelve different VO<sub>2</sub>max prediction models have been developed. The generalization error of the prediction models has been assessed by performing 10-fold cross-validation, and the prediction errors have been calculated using standard error of estimate (SEE) and multiple correlation coefficient (R). The results of the SVM-based prediction models have also been compared to those of three types of artificial neural networks including Multilayer Perceptron (MLP), General Regression Neural Network (GRNN) and Radial Basis Function Neural Network (RBF).

According to the results obtained, the model containing the physiological variables gender, age and height; the maximal variable MX-HR; and the submaximal variables SM-MIN1, SM-MIN2, SM-MIN3 and SM-HR3 yields the lowest SEE's and the highest R's for prediction of VO<sub>2</sub>max, no matter whether SVM, MLP, GRNN or RBF have been employed for model development. Among the regression methods, SVM has been found to deliver the lowest SEE and the highest R values with 2.49 mL kg<sup>-1</sup> min<sup>-1</sup> and 0.90, respectively. Building the same prediction model with MLP gives the second most accurate prediction with an SEE value of 2.58 mL kg<sup>-1</sup> min<sup>-1</sup> and R value of 0.89; whereas the development of the model with GRNN yields the third most accurate prediction with an SEE value of 2.99 mL kg<sup>-1</sup> min<sup>-1</sup> and an R value 0.86. RBF-based model, in contrast, leads to relatively the highest SEE and lowest R values with 3.16 mL kg<sup>-1</sup> min<sup>-1</sup> and 0.84, respectively.

Moreover, the following observations could be gained:

- VO<sub>2</sub>max can be predicted with lower SEE's and higher R's using less number of predictor variables. In particular, using the most accurate prediction model instead of the model consisting of the full set of predictor variables yields 3.45%, 4.23%, 2.39% and 13.82% decrement rates in SEE's for SVM, MLP, GRNN and RBF, respectively.
- In general, SVM-based prediction models show the best performance in terms of achieved SEE and R values for prediction of VO<sub>2</sub>max. MLP based models, on the other hand, perform better than GRNN-based model; whereas GRNN-based models outperform RBF-based prediction models.
- When the number of predictor variables included in the prediction models falls below 6, a significant increase in the corresponding SEE values can be observed. The SEE's of such SVM-based prediction models vary between 3.73 mL kg<sup>-1</sup> min<sup>-1</sup> and 5.67 mL kg<sup>-1</sup> min<sup>-1</sup>; whereas the SEE's of the artificial neural network (i.e. MLP, GRNN and RBF) based prediction models change between 3.84 mL kg<sup>-1</sup> min<sup>-1</sup> and 5.76 mL kg<sup>-1</sup> min<sup>-1</sup>.
- Depending on the prediction model, the execution times required by SVM change between 40 seconds and 2 minutes; whereas the execution times of MLP-based and GRNN-based prediction models are comparable, varying between 2 and 5 seconds. RBF-based models, in contrast, require execution times up to 3 minutes.
- As compared to the results of the other single prediction models in literature that were built using maximal or submaximal variables only, the reported SEE and R values of the SVM-based hybrid model consisting of both maximal and submaximal variables in this study are more accurate.

# Performance Comparison of Different Machine Learning Methods for Network Traffic Forecasting

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**Keywords:** machine learning, traffic forecasting

Amount of Internet traffic is rising, and several and large number of packets are sent through all over the world. Nowadays, knowing characteristics of the Internet traffic becomes very important. Also, the characteristic of Internet traffic is getting more and more sophisticated, and this creates new difficulties to the management of the network. In order to overcome these problems, development of network traffic forecasting models have become one of the most active research areas. A traffic forecasting model needs to be able to express the characteristics of the network in the past and also, needs to be able to forecast the development of this network in the near future. At the same time, traffic forecasting can help to reveal irregularities by checking the real traffic against the forecast. This can outcome with an earlier detection of problems that will lead to a more trustable service. The field of Time Series Forecasting considers the prediction of chronologically sorted predictors where the aim is to identify a complicated system as a black-box and forecasting its behavior based on historical data.

In literature, to the best of our knowledge, although there exists several studies which predict the network traffic with the help of statistical as well as machine learning regression methods, there is no comprehensive study that compares the performance of different machine learning methods for prediction of network traffic on different datasets using several time lags.

In this study, Support Vector Machine (SVM), Multilayer Perceptron (MLP), Radial Basis Function Neural Network (RBF) and Random Tree (RT) have been used to precisely forecast the amount of traffic in TCP/IP-based networks. The dataset includes traffic data (in bits) from Internet Service Providers with centers in 11 European cities. The first 66% of the dataset has been utilized as a training set, and the rest has been utilized as a test set. To develop forecasting models, two different lags for each time scale (5-minute, 1 hour and 1 day) were used. For the 5-minute dataset, the lags used are {1, 2, 3, 5, 6, 7, 11, 12, 13} (referred as 5-minute-lag1) and {1, 2, 3, 5, 6, 7, 287, 288, 289} referred as (5-minute-lag2); for the hourly dataset, the lags used are {1, 2, 3, 24, 25, 26} (referred as hourly-lag1) and {1, 2, 3, 24, 25, 26, 168, 167, 169}} (referred as hourly-lag2); and for daily dataset, the lags used are {1, 7, 8} (referred as daily-lag1) and {1, 2, 3, 6, 7, 8} (referred as daily-lag2). The mean absolute percentage error (MAPE) has been used to assess the performance of forecasting models.

Based on the results obtained, the following discussions can be stated:

- In general the MAPE values range from 2.90% to 17.23% for the 5-minute dataset, from 5.64% to 29.97% for the hourly dataset, and from 5.75% to 13.46% for the daily dataset.
- Generally, the results show that the smallest time scale (i.e. 5 minute) gives better results than the largest time scale (i.e. daily) for all methods except for RBF.
- When the lengths of lags are examined, the lags having short length scales (i.e. 5-minute-lag1 and hourly-lag1) or less number of elements (i.e. daily-lag1) give better results for all datasets with a single exception. More specifically, the lags with short length scales or less number of elements give 16.69%, 9.84%, and 17.30% lower MAPE values on the average than the other lags for the 5-minute, hourly, and daily datasets, respectively.
- Among the machine learning methods used, the ranking of the methods in terms of their prediction performance based on the average values of MAPE's is MLP, SVM, RT and RBF for the lags having the shorter length scale or less number of elements. As for the other lags, the ranking of the methods is SVM, RT, MLP and RBF.
- SVM gives the lowest MAPE values, while RBF yields the highest MAPE values for both lags for the 5-minute dataset.
- When the results of the hourly dataset are analyzed, it is observed that SVM gives the lowest MAPE values while RBF gives the highest MAPE values for hourly-lag1. However, on the same dataset, the performance of MLP is better than that of SVM for hourly-lag2, while RBF still exhibits the worst performance.
- When the results of the daily dataset are examined, it is easily seen that ANN gives the lowest MAPE values while RBF gives the highest ones for daily-lag1. On the other hand, RT gives the lowest MAPE values on the same dataset for daily-lag2.

# **A New Data Reduction Algorithm for Improving the Performance of Support Vector Machines on Maximal Oxygen Uptake Prediction**

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**Keywords:** support vector machines, data reduction, maximal oxygen uptake

Maximum oxygen uptake (VO<sub>2</sub>max) is defined as the maximum ability to transport and consume oxygen during strenuous endurance exercise and is considered the single best measure of cardiorespiratory fitness (CRF). There exist several machine learning based models in literature to predict VO<sub>2</sub>max of subjects. In this study, a new approach (i.e. data reduction algorithm) for improving the performance of Support Vector Machines (SVM) on prediction of VO<sub>2</sub>max has been proposed. The approach is based on the elimination of irrelevant samples from the training data during the training phase by taking into account the absolute prediction errors of each sample. The samples that have prediction error values higher than a specified threshold have been removed to form new training data. The performance of the proposed approach has been compared with the two widely used outlier detection algorithms including Z-score and Grubbs' test. A detailed comparison of the proposed data reduction algorithm and the outlier algorithms named as Z-score and Grubbs' test is given below:

1. In the proposed data reduction algorithm, irrelevant sample determination is carried out during training phase whereas the same occurs before training in the outlier detection algorithms.
2. The proposed data reduction algorithm uses absolute errors between the predicted and actual values to determine irrelevant samples. Outlier detection algorithms use different statistical methods for the same purpose.
3. The proposed data reduction algorithm presents intelligent and dynamic elimination of irrelevant samples whereas outlier detection algorithms use static elimination for the same purpose.
4. The performance of the proposed data reduction algorithm depends highly on the selection of the value of the threshold. The performance of the Grubbs' test depends on the value of the significance level, degrees of freedom, mean, standard deviation and data set size whereas the performance of the Z-score depends on the mean, standard deviation and threshold value.
5. The proposed data reduction algorithm is more selective compared to the outlier detection algorithms.

6. The disadvantage of the proposed data reduction algorithm is that it is more time consuming than the outlier detection algorithms owing to the fact that irrelevant sample determination is carried out during training phase yielding double training for developing the prediction models.

To apply the new data reduction algorithm for improving the performance of SVM on VO<sub>2</sub>max prediction, a dataset including data of 185 college students (115 males and 70 females), aged from 18 to 26 years has been utilized. The data set contains 10 predictor variables which are gender, age, weight, height, submaximal times (MIN1, MIN2 and MIN3) and heart rates (HR1, HR2 and HR3). 70% of the data is used for the train set and the rest of the data is used for the test set. 21 different regular SVM-based, improved SVM-based and outlier-based VO<sub>2</sub>max prediction models have been developed. The performance of the prediction models have been evaluated by calculating their standard error of estimates (SEE's) and multiple correlation coefficients (R's).

Based on the obtained results, the following points can be stated:

- Improved SVM-based prediction models perform better than regular SVM-based models. The average decrement rates in SEE's of the improved SVM-based prediction models with respect to the SEE's of the regular SVM-based models is 10.49%.
- Improved SVM-based prediction models perform better than outlier-based models. The average decrement rates in SEE's as compared to the SEE's of the regular SVM-based models are 2.87% for the Z-score, 3.49% for the Grubbs' test and 10.49% for the improved SVM-based models.
- The model including the submaximal predictor variables MIN3 and HR3 yields the lowest SEE's (2.40 for regular SVM-based and 2.73 for improved SVM-based), whereas the model including the submaximal predictor variables HR1, HR2 and HR3 yields the highest SEE's (4.09 for regular SVM-based and 4.48 for improved SVM-based).
- The prediction model including the submaximal predictor variables MIN2, MIN3, HR2 and HR3 yields the second best performance for regular and improved SVM.
- For the best model, the decrement rate in SEE's between improved SVM-based and regular SVM-based prediction models is 11.98%.

# **New Prediction Models for Upper Body Power of Cross-country Skiers Using Machine Learning Methods with Minimum-redundancy Maximum-relevance Feature Selection Algorithm**

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**Keywords:** machine learning, feature selection, upper body power, cross-country skiers

Upper body power (UBP) is one of the most important factors affecting the performance of cross-country skiers during races. Although some few studies have already attempted to use a feature selection algorithm to reveal the most discriminative features for prediction of UBP, they only applied the Relief-F feature selection algorithm to determine the ranking of all predictor variables.

The purpose of this study is to develop new prediction models for predicting the 10-second UBP (UBP10) and 60-second UBP (UBP60) of cross-country skiers by using General Regression Neural Networks (GRNN), Single Decision Tree (SDT) and Tree Boost along with the minimum-redundancy maximum-relevance (mRMR) feature selection algorithm that have never been applied for development of UBP prediction models.

The dataset includes 75 (38 females and 37 males) healthy volunteers ranging in age from 15 to 25 years. The predictor variables in the dataset are protocol, gender, age, weight, height, maximum oxygen uptake (VO<sub>2</sub>max), maximum heart rate (HR<sub>max</sub>), time and heart rate at lactate threshold (HRLT) whereas 10-second UBP (UBP10) and 60-second UBP (UBP60) are the target variables.

Based on the ranking scores of predictor variables assigned by the mRMR feature selection algorithm, 18 different models have been developed for prediction of UBP10 and UBP60. By using 10-fold cross-validation, the efficiency of the prediction models has been calculated with their multiple correlation coefficients (R's) and standard error of estimates (SEE's).

The outcomes display that using less amount of predictor variables than the full set of predictor variables can be useful for prediction of UBP10 and UBP60 with comparable error rates. The model consisting of the predictor variables gender, weight, height, VO<sub>2</sub>max, time, age and HR<sub>max</sub> yields the most reduced SEE's for prediction of UBP10, while the model including the predictor variables gender, age, weight, VO<sub>2</sub>max, HRLT, height and HR<sub>max</sub> gives the most reduced SEE's for prediction of UBP60, whichever regression method is used. Using these two models instead of the full set of predictor variables yields up to 8.80%, 5.20% and 8.26% decrement rates on the average in SEE's for GRNN, Tree Boost and SDT, respectively. Also, observation of the SEE's of the model including the predictor variables

gender, weight, height and VO2max and the model including the predictor variables gender, weight, height, VO2max and time suggests that the predictor variable time provides a significant improvement for prediction of UBP10. In more detail, the inclusion of time in the aforementioned model leads in average 10.92% reduction in SEE for predicting UBP10. A similar case is observed when the SEE's of the model including gender, age and weight and the model including gender, age, weight and VO2max are compared. In particular, the addition of VO2max in the related model causes in average 13.76% decrement in SEE for prediction of UBP60. In addition, GRNN outperforms the other regression methods, whereas SDT exhibits the worst performance in terms of prediction accuracy, regardless of which prediction model is utilized and whether UBP10 or UBP60 is predicted. Additionally, as compared to the SEE's obtained by Tree Boost and SDT, the average percentage decrement rates in SEE's obtained by GRNN are 14.82% and 38.41% for prediction of UBP10, and 13.69% and 47.46% for prediction of UBP60.

There exists a single study in literature which has already developed various models that have been created by predictor variables ranked with the Relief-F feature selection algorithm for prediction of UBP10 and UBP60 of cross-country skiers based on Support Vector Machines (SVM), Multilayer Perceptron (MLP) and Multiple Linear Regression (MLR). It has been concluded in this study that SVM based models produced much lower SEE's and higher R's than the ones given by MLP and MLR. When GRNN based models are compared with SVM based models, it is seen that the average percentage rates in SEE's of GRNN based models are 9.31% and 8.28% lower than that of SVM based models for prediction of UBP10 and UBP60, respectively.

# Reverse Supply Chain Network Design Using Particle Swarm Optimization Algorithm

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**Keywords:** Network Design, Particle Swarm Optimization Algorithm, Reverse Supply Chain

In supply chain management, extension of traditional forward supply chain to involve reverse flow of end-of-life or used products (materials), creates reverse supply chain term. Companies should manage reverse supply chains by incorporating reverse supply chain issues to their businesses in order to gain value. In reverse supply chain management, a well designed network ensures the performance of the chain. This paper proposes a particle swarm optimization algorithm for modeling reverse supply chain network. Candidate solutions are represented by priority based encoding in the proposed algorithm. The objective of the algorithm is to design reverse supply chain network with maximum profit by determining number and location of facilities, material flow channels and amount of flow in designated channels of the network. To evaluate the performance and to illustrate the applicability of the proposed algorithm numerical experiments are performed. Attained results showed that the proposed algorithm gives effective and efficient solutions for reverse supply chain network design problems.

# **A Genetic Algorithm Approach for Green Supply Chain Network Optimization**

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**Keywords:** Green Supply Chain, Genetic Algorithm, Network Optimization

With the increasing importance of environmental issues and environmental standards, companies began to apply green design for their supply chains. Greenness for a supply chain can be in design of products or operations level. Green operations include green manufacturing, network design, waste management, reverse logistics etc. The effects of environmental issues in supply chain network design, which has a significant task in performance of a chain, should be analyzed attentively. The scope of this paper is to develop a genetic algorithm for green supply chain network optimization. One of the most popular metrics for measuring environmental impact of network design, carbon footprint and environmental impacts in investment decisions are considered in the algorithm. Illustrative examples are performed in order to evaluate the performance of the proposed algorithm. Obtained results showed that the proposed algorithm gives effective and efficient solutions for green supply chain network design problems and it can be used as a tool for measuring environmental impacts of supply chains.

## **Differential Evolution Algorithm To Solve Truck-Dock Assignment Problem of Cross-Docks**

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**Keywords:** Cross-docking, truck-dock assignment, differential evolution algorithm

This study considers the truck-dock assignment problem of the cross-docking facilities with 2-dimensional product allocation constraints in order to use capacity more efficiently. The truck-dock assignment problem of cross-docking center can be described as finding the best assignment plan of the incoming and outgoing trucks to dock doors. The aim of the study is to find best assignment plan for the incoming and outgoing trucks in order to minimize total transportation distance of the products in cross-docking centers. In addition to the truck-dock assignment operations, product allocation plans are taken into account in order to identify movements in cross-docking center more realistic. This problem is formulated with mixed integer programming and solved using differential evolution algorithm. Proposed algorithm is performed for several randomly generated problems. Results show that proposed algorithm exposes effective solutions with 2-dimensional product allocation constraints.

# **A Heuristic Algorithm Approach for the Green Vehicle Routing Problem with Cross-Docking Center**

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**Keywords:** Vehicle routing, cross-docking, simulated annealing algorithm

In this study, vehicle routing problem with cross-docking center is studied in terms of the vehicle fuel consumptions. Cross-docking centers, which is one of the lean logistics applications and emphasized by many companies nowadays, differ from the classical warehouses or distribution centers in that the products are transported from suppliers to customers through cross-docking centers frequently and without storing them for a long time. The vehicle selection for the transportation of the products in network must be planned efficiently because of the distinctive capacity and fuel consumption values of the different vehicles in heterogeneous fleet. In order to minimize the fuel consumption and also the transportation costs of the vehicles used for product transportations, a simulated annealing based heuristic algorithm is proposed for the problem. Computational results show that proposed simulated annealing algorithm provides efficient solutions to minimize total fuel consumption amount for transportation operations.

## **Preliminary Investigations into Geothermal Energy Potential of Gulf of Izmir and Surrounding by Using Airborne Magnetic Anomalies**

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**Keywords:** Airborne, Magnetic, Izmir Gulf, Geothermal, Faults

Magnetic anomalies can be used to explore the geothermal energy potential. Magnetic surveys can be done on land, sea surface as well as from the air. Airborne magnetic surveys are fast and efficient ways of exploring the magnetisation of the ground. If there are upper crustal or crustal magnetised substances these can be seen on the airborne magnetic anomaly maps. Airborne magnetic anomalies of Izmir Gulf and surrounding region of western Turkey were surveyed by the General Directorate of the Mineral Research and Exploration and show several intense amplitude of anomalies. I took two cross-sections of profiles from the gulf of Izmir towards Seferihisar town and near Izmir along the northwest and south eastern directions. These profiles were digitised to process the data. Power spectrum analyses of these profiles show separate sources at different depths. It was not easy to determine the depths of the sources from the power spectrum alone because of the short lengths of the profiles and low resolution of digitising. On another way, depth estimations by means of half-width method for simple geometric bodies suggest deep sources in the south western profile and shallow sources in the north eastern profile. Natural steam source of Seferihisar to the south-west of Izmir is well known. There is also a hot-spring in Doganbey. These locations are about 90 kilometres south west of Izmir. These sources are along the south west projection of the airborne magnetic anomalies. Magnetic anomalies passing through Izmir to Manisa can also be correlated with the strike-slip faults of the active fault map of Turkey. Furthermore, magmatic material arising from the magma can fill inside the strike-slip faults causing magnetic anomalies. Such bodies are also important for the geothermal energy potential as the internal heat of the earth ascends to near surface. As a conclusion, I suggest that the geothermal energy potential of the region is more than the observed.

## Compressive Sensing of Sparse Signals and MR Images

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**Keywords:** compressive sensing (CS), sparsity, Matlab graphical user interface (GUI), magnetic resonance imaging (MRI)

The sparsity of a signal means that it can be represented by a small number of non-zero coefficients in a certain basis. The reconstruction of a sparse signal can be done from sub-Nyquist samples by using nonlinear optimization, which is known as “compressive sensing (CS)”. CS is a very promising technique in wide range of areas e.g. wireless healthcare systems, medical imaging such as MRI since CS enables low-power and cost-effective data processing. Most of these applications have been possible since the real world signals such as sound, image are inherently sparse. In this work, a Graphical User Interface (GUI) is developed in Matlab which can be used to do CS based reconstruction of sparse signals and MR images. This program is devoted to the scientists and researchers who desire to explore the quality of reconstruction from sub-Nyquist data and the effect of the parameters in the algorithm based on CS.

# **An Artificial Bee Colony Algorithm for Open Vehicle Routing Problems**

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**Keywords:** Artificial bee colony algorithm, open vehicle routing, meta-heuristics

Artificial bee colony algorithm (ABC) is one of the recently introduced swarm based meta-heuristic algorithms. ABC mimics the foraging behavior of honey-bee swarms. The Open Vehicle Routing Problem (OVRP) is a variant of the classic vehicle routing problem, where vehicles do not return to the depot after the service of the customers. In this study, an improved version of ABC is presented to solve OCP's. Two sets of benchmark instances were used in order to test the proposed algorithm. The computational experiments indicate that the improved ABC is very efficient in terms of both solution quality and time.

# **A Binary Electromagnetism-like Algorithm for Wind Turbine Placement Problem**

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**Keywords:** Electromagnetism-like algorithm; wind turbine placement

This study proposes a binary electromagnetism-like algorithm (bEMA) for optimal placement of wind turbines within a wind farm. The objective of the problem is to maximize the wind farm efficiency. Moreover, linear wake model is used to calculate downstream wind speed. Electromagnetism-like algorithm (EMA) is a relatively new physics-inspired meta-heuristic algorithm, which mimics the behaviors of charged particles in an electrical field. In this paper, an improved binary version of EMA is proposed and tested on several cases. Three well-known benchmarks cases are considered; (i) unidirectional uniform wind, (ii) uniform wind with variable direction, and (iii) non-uniform wind with variable direction. Experiments are conducted and proposed EMA is compared to other efficient meta-heuristic algorithms. Results reveal that bEMA outperforms other competitor algorithms.

# The Performance Analysis of Applications Written Using MVP and MVC

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**Keywords:** Model View Controller (MVC), Model View Presenter (MVP), performance analysis

Model View Controller (MVC) is an architectural pattern introduced at the end of the 70s. The aim of MVC is the interaction of components in the view layer among themselves and with the rest of the system as well as the placements of these components. It is described as the separation of business logic from user interface code. In this way, if we want to make any changes to the view layer, we can do easily without causing any problems or changes to business logic. Model View Presenter (MVP) is the structure that retrieves user interface code (flow between pages, functioning within the user interface, etc.) in view class and carries into a different Presenter class. Thus, it can be operated and tested independently from the creation and rendering of code user interface related to the presentation.

In the present study, two applications have been written using Model View Presenter (MVP) and Model View Controller (MVC) with the same requirements. To compare applications written using MVP and MVC, JMeter and speedy framework monitoring comparing tools and analysis results have been presented. MVP has been found to be more advantageous than MVC. In addition, during the encoding process by way of mocking the layers in model class, the necessity of acquisition of model data has been eliminated. The development process has been maintained without the need for database, network connection, file access, etc. And thanks to the mocking of view classes, testing of applications during the development and the creation of user interface has been unnecessary. Changes in the user interface can be made in a much easier and safe manner. After all, the changes to be made here will not affect the process in any way. The advantage of MVP over MVC can be summarized as the ease of testability and less code dependency.

## **Human-face Detection and Tracking in Real-time Videos**

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**Keywords:** Face detection, Kalman süzgeci, HOG, Viola & Jones

Digital images and videos used for signal processing have nowadays become increasingly more sophisticated and widespread. Researches on image processing, have received considerable attention for a decade due to its potential applications in human-face detection and tracking. The main objective of this research work is to present a human-face detection and its tracking based a combined approach for real-time videos. At first, two-class classifier has been designed and training has been realized by using Support Vector Machines (SVM). Thanks to training results, human-face and its coordinates have been detected on the video frame by using Histograms of Oriented Gradients (HOG) or Viola & Jones method at the second step. When human-face cannot be detected, the human-face coordinates have been robustly estimated by the Kalman filter widely used on estimation algorithms. Thus, the performance of the human-face tracking is increased. Experimental results show that the presented approach is very suitable for real-time human-face tracking on real-time videos.

# **A Study of Laminar Natural Convection in Annular Spaces Between Differentially Heated Horizontal Circular Cylinders Filled with Non-newtonian Nano Fluids**

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**Keywords:** heat transfer, circular space, non-Newtonian, nano fluid, computational fluid dynamics

Heat exchangers are one of the most widely used systems in factories, refineries etc. In this study, natural convection heat transfer using nano-fluids in between two cylinders is numerically investigated. The inner and outer cylinders are kept at constant temperatures. One of the most important assumptions in the project is that the working fluid is non-Newtonian. In recent years the use of nano-fluids in industrial applications has increased profoundly. In this study nano-Newtonian fluids containing metal particles with high heat transfer coefficients have been used. All fluid properties such as homogeneity has been calculated. In the present study, solutions have been obtained under unsteady conditions, base fluid was water, and effects of various parameters on heat transfer has been investigated. These parameters are Rayleigh number ( $103 < Ra < 106$ ), power-law index ( $0.6 < n < 1.4$ ), aspect ratio ( $0 < AR < 0.8$ ), nano-particle composition, horizontal and vertical displacement of the inner cylinder, rotation of the inner cylinder, and volume fraction of nanoparticles. Results such as the internal cylinder average and local Nusselt number variations, contours of temperature, flow lines are presented. The results are also discussed in detail. From the validation study performed it was found that a very good agreement exists between the present results and those from the open literature. It was found out that the heat transfer is always affected by the investigated parameters. However, the degree to which the heat transfer is affected does change in a wide range.

# Centralized Regional-based Decision Making and Management System for Effective Advertisement

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**Keywords:** Big Data, Decision Making, Effective Advertisement Management, Text recognition

In this paper, centralized regional-based decision making and management system is proposed for effective advertisement on the billboards in the urban areas. The system will be used in the advertising industry and will analyze big data obtained through the social media (e. g., Twitter, Facebook, Instagram etc.) for decision making on corresponding advertisements. Nowadays, advertisements have been published and displayed on digital billboards randomly and most of those adverts don't address to the people who are shopping or travelling in the regional areas. This will cause several issues such as visual pollution, non-effective advertisement visualization, cost consumption etc. With the proposed approach, the data entered on the social media by the people in regional areas will be obtained for analyzing the requirements and desires of the community. Thus, advertisements will be chosen based on the social demand in specific regional areas and the selected advertisements addressing to the people will be displayed on the digital billboards. Based on the people's demand in the urban areas, different advertisement may be published for each region. Also, duration and frequency of the advertisements on digital billboards may also be organized depending on the needs and behaviors of people in the public areas.

## **Real Time Smart Door System for Home Security**

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**Keywords:** Smart Door System, Raspberry Pi, Multimedia and Speech Communication, Security and Safety

This paper presents a real time smart door system for home security. Most of the proposed smart home systems try to bring solutions for this security problem, but many of those systems use numerous sensor devices. With the increasing security issues, it is necessary to use new technologies. Video based smart home security systems have recently become an efficient approach with the development of video technology and Raspberry Pi is a strong and reliable embedded system device for the complex and challenging tasks. Using these both technologies in the proposed system will bring several advantages in providing safety and security in terms of visualizing and identifying people who visit the home. In the overall proposed system, there will be two different significant techniques to provide home security. One is to use video technology to see the front door in real time even home is empty and another is to provide communication between the door system and smart phone device. By connecting the smart door system with the mobile phone through the cellular network, the owner of the house may have several opportunities such as controlling the house, getting instant video streaming, receiving and sending message, talking to the visitor and starting the alarm system. The experimental results indicate that the proposed system may provide the consistent support and assistance for safe and secure life.

## Sourcing Decisions and Order Allocation with Fuzzy Demand

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**Keywords:** Sourcing, Order Allocation, Fuzzy Demand, Mixed Integer Linear Programming

In today's competitive world, fast economic changes and the increasing pressure of market conditions, lead enterprises to focus on supply chain activities. Within supply chains activities, selecting appropriate sourcing alternative based on the quantitative and qualitative criteria can help companies move toward development. Although the combination of sourcing decision making and order allocation problem have been investigated by many researchers, the problem is still so popular due to its importance for strategic development of the enterprises. This paper proposes a multi-objective mixed integer programming model to deal with sourcing decision making and order allocation with fuzzy demand. To have an available decision-making system is becoming a crucial issue for organisations in a constantly fluctuating environment where the economic uncertainty needs mathematical models. To overcome the uncertainty of the economic environment; the demand pattern is characterized by triangular fuzzy numbers. Triangular fuzzy numbers are preferred due to its appropriateness to the experienced knowledge for the demand pattern in this study. The objective functions of the multi-objective mixed integer programming model are maximization of the quantitative evaluations of the sourcing alternatives and minimization of the cost terms. The proposed model is implemented using real data of apparel industry and solved by using weighted sum method and  $\epsilon$ -constraint method. The results of the model show that the proposed model is an efficient tool to evaluate sourcing alternatives and determine order quantities among alternatives under fuzzy demand.

## **Fuzzy Topsis Method To Evaluate Freight Village Locations in Turkey**

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**Keywords:** Freight Villages, Fuzzy Topsis, Multicriteria Decision Making

A freight village is defined as a specialized area where all the transportation activities, logistics, warehousing and goods distribution - both for national and international lane - are carried out, on a commercial basis, by various companies. As a significant logistics transfer center between Asia and Europe, Turkey is supposed to be a logistics center. The logistics sector and government organizations focused on to determine the optimum locations for freight villages because transportation costs constitute big part of the total product costs due to energy prices in Turkey. To find an optimum place for freight villages is a complicated task because of the fact that various criteria or objectives must be simultaneously considered in the decision making process. In this paper Fuzzy TOPSIS is used to evaluate the alternative locations for freight villages in Turkey considering both quantitative and qualitative criteria. The paper includes the applicability and performance of the proposed methodology.

# Unsupervised Satellite Change Detection Using Particle Swarm Optimization in Spherical Coordinates

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**Keywords:** Landsat image change detection, Spherical transformation, Binary particle swarm optimization, Remote sensing

In the last decade, there has been tremendous escalation in the development of change detection techniques for the analysis of multitemporal landsat satellite images. This escalation stems from the fact that there are many important remote sensing applications in which change detection can be applied, such as environmental measurement (e.g. deforestation, land degradation and desertification), forestry management, regional mapping, urban monitoring, and widespread disaster measurement (e.g. forest burned area, landslide and flooding).

In remote sensing context, change detection can be defined as the process of identifying differences between corresponding objects or phenomenon by analysing two aligned remote sensing images which are captured at different times. Such an analysis aims at detecting and identifying land cover changes that can be done manually via visual inspection or automatically by change detection methods. Manually labelling and identifying changes is a cumbersome task and it is prone to errors and highly subjective depending on the expertise of the inspector. Therefore, many methods have been proposed to automatically find changes through the satellite images. Generally, change detection methods can be classified into supervised and unsupervised approaches.

The supervised approach is based on classification methods, which needs a training set with multitemporal ground truth to learn patterns which can be used to identify changes. Although this approach exhibits some advantages over the unsupervised one, the generation of ground truth information is usually a tedious, difficult and expensive task. Consequently, the use of unsupervised change-detection approach is vital in many applications in which ground truth does not exist.

The unsupervised methods directly compare multi-temporal images or process the difference image using pattern recognition techniques. In this approach, there is no need for a training set. In the literature of unsupervised change detection approach, changes are mostly detected from multitemporal greyscale images. Many algorithms have been developed for dealing with this problem, such as image difference, Principle Component Analysis, Markov Random Field, and sequential-based method (i.e. genetic algorithm based method). Most of the existing unsupervised change detection methods have three main problems. First, they use one spectral band to obtain the difference image. This is a disadvantage as converting RGB

images to greyscale images may affect discrimination between changed and unchanged regions of the difference image. Second, the effect of illumination variations, which are highly influential in discriminating between changed and unchanged pixels, has been discarded from the unsupervised change detection methods. However, in the field of change detection for remote sensing applications it is often necessary to cope with the phenomenon of illumination changes as it causes significant changes most of the times so that pixels may incorrectly be selected as change by an algorithm. Thus, using greyscale images and discarding illumination changes may cause to obtain high miss or false alarm rates. Hence, it is important to design a multispectral cost function which is robust to illumination changes in order to improve the change detection performance in terms of accuracy rate. Third, as the size of images involved in remote sensing tends to be quite large, the complexity of comparing and analysing them for finding changes increases and needs more time. Therefore, the sequential based change detection methods need a large number of iterations to find the final change detection mask or optimum result. Therefore, it is necessary to apply an effective optimization method to minimize the change detection cost function efficiently.

Here, we propose a new photometric invariants unsupervised satellite change detection method, which is robust to illumination changes. To achieve this, the RGB colour space is transformed into  $r\Phi\Theta$  colour space via spherical transformation of RGB coordinates. Then, a cost function based on image difference is defined and optimized by using Binary Particle Swarm Optimization (BPSO) algorithm. Note that in our method, instead of calculating perceived colour difference of images, the difference of  $\Phi$  and  $\Theta$  channels are calculated. The reason that the  $\Phi$  and  $\Theta$  channels are only selected from spherical coordinates is because they are invariants with respect to shadow and shading. However, the colour magnitude  $r$  is not a photometric invariant. The cost function is used to find the weak and strong changes by updating the population in BPSO, iteratively. To improve the convergence rate of the proposed method, we use an initial binary change detection mask which is obtained by a pre-processing method in the population.

We assess the performance of the proposed method by qualitative and quantitative tests on real multi temporal multi spectral data sets. The performance of the proposed method is evaluated by comparison with four existing change detection methods. To validate the results, three different quantitative error measures like false and miss alarm rates and total error are calculated. To achieve this, the obtained change masks are compared with the corresponding ground truth mask. The results show that the proposed method provides great performance to find the optimal change detection mask. The total error shows that our method is at least 0.64% better than the best compared method and is at most 13.36% better than the worst one.

## A Performance Study for Harmony Search Algorithm

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**Keywords:** Bridge and Torch Problem, Harmony Search Algorithm, Optimization problems, Heuristic Algorithms

Mathematical techniques are not sufficient methods for finding solution of the real world problems. Hereby, heuristic optimization techniques have been developed. One of these techniques is Harmony Search (HS) algorithm, developed to find better solution with decreased number of iterations against the existed optimization techniques. The algorithm has parameters such as Harmony Memory Considering Rate (HMCR), Pitch Adjustment Rate (PAR), whose values are should be predetermined before experiments run. Values of these parameters play a critical role by generating solutions. To reveal this assumption, we solved Bridge and Torch problem (BT) with HS algorithm. BT is a combinatoric problem and it's optimal solution is known for several parameters. We run adapted HS algorithm for several n, PAR and HMCR values, n shows number of people in BT problem. Experiment results show that if the best values for parameters cannot be selected, the global solution may not be reached in acceptable time.

# Automated Black-Box GUI Testing for Revealing System Bugs in Mobile Applications

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**Keywords:** automated testing, gui testing, black-box testing, mobile applications, model-based testing

As smartphones came to dominate mobile communications, many applications that target these devices filled app stores with an exponential rate. If these applications don't meet customer needs, i.e. if they are buggy, slow etc., they are bound to wither away from sight. This brings the need for thorough testing, particularly for graphical user interfaces, through which users interact with the application. Existing automatic methods for testing generally involve white-box testing, and for the most part such testing is unable to detect GUI errors. Companies recruit testers to compensate for this need, however testers are not always able to track the interaction sequence that caused a bug, thus some bugs remain non-reproducible. There is, however, some work in literature aiming to automatically test a user interface via a sequence of automated user actions. Such works can be categorized into random, model-based, model learning methods. This paper aims to inspect how guided GUI testing is realized; specifically using model-based and model-learning methods. The main focus is to elucidate the shortcomings of current methods, such as automatically entering text inputs, deciding which action to trigger or determining if the model was built correctly. Such shortcomings are open to interpretation by artificial intelligence and machine learning techniques, and for some of them solutions are already presented yet not widely known or used. For others, randomized methods are utilized. By revealing aforementioned shortcomings this paper plans to raise new research questions in the area of software testing.

## Wireless Remote Control of a Mobile Robot

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**Keywords:** Remote Control , Communication with RF (Radio Frequencies)

In this study, a mobile robot serving in dangerous and narrow areas for human is designed. The mobile robot consists of a mobile platform and 4-dof robot arm with a gripper. This robotic system can be controlled via either a computer based interface program or a microprocessor controlled module independently operated.

The communication between the user and mobile robot is provided by transmitting wirelessly the data from a RF transmitter module to a RF receiver on the mobile platform. The user transfers the data to the USB port of the computer using the designed interface program. The control operation is performed by processing this data with a designed microcontroller board. Furthermore, the objects in the environments and direction of the mobile robot can be seen with cameras and laser LED on the robot at day and night.

## Comparison of ANN, CF and LR Methods for Harmonic Estimation

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**Keywords:** Power Distribution System, Artificial Neural Network, Curve Fitting , Linear Regression ,Harmonic , Power Quality, THD

Power quality is an important criterion in electrical power systems. Harmonics negatively affect the power quality. Harmonic analysis and estimation have been made with various methods in the literature. In this study Artificial Neural Network (ANN), Curve Fitting (CF) and linear regression (LR) models have been developed for the estimation of the  $[[THD]]_I$  values. Some of the measured data have been used to generate models, the remaining part have been used to test the model. Estimation results obtained from the ANN, CF, LR models have been compared each other. Estimated  $[[THD]]_I$  values obtained from ANN,CF,LR models were close to real  $[[THD]]_I$  values so that ANN,CF,LR models can be used can be used for the  $[[THD]]_I$  estimations. With this way future planning the power systems can be made to increase the power quality in electrical power systems.

## **Biosignal Processing and Medical Imaging (BSPMI) Software Package Based on Matlab GUI for Education and Research**

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**Keywords:** biosignals, medical imaging, MATLAB GUI, engineering education, software package.

Laboratory experiments and practical applications of biomedical courses are very important for engineering students by improving their skills in solving and fixing practical problems. The software package developed in this paper has educational effect and introduced economical solution without using various and expensive biomedical experimental equipment or needing wide spaces.

In this paper a developed Biosignal Processing and Medical Imaging (BSPMI) Software Package based on Graphical User Interface (GUI) using MATLAB have proposed which can be used for students and researchers in medical and biomedical engineering instruments labs.

This package consists of two main modules; the first one deals with the processing of different biosignals, especially Electrocardiograph (ECG), Electroencephalograph (EEG) and Electromyography (EMG) signals while the second one introducing different image modalities such as X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and functional Magnetic Resonance Imaging (fMRI).

This package can open a new line for undergraduate and postgraduate students and researchers on how they can use these biosignals and images in the future for processing and finding the characteristics related to them, also help them in subsequent analysis of different biomedical signals, techniques and image data; while by designing the fMRI graphical simulator in the second module is aimed to improve the student's learning and understanding of some basic aspects of fMRI.

In sum, BSPMI Software Package has designed and implemented as part of biomedical instrumentation course, so it can be easily used by students/researchers using only standalone application or executable file (exe file) without installation of MATLAB program.

# **An Improved Dynamic Programming Method for Security-Constrained Unit Commitment**

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**Keywords:** Minimization of fuel cost, load shedding, Power flow, Thermal units, Security-constrained unit commitment

In the literature, various techniques have been incorporated or applied to develop an optimal unit commitment schedule that efficiently minimizes cost, while maintaining the security of the system and meeting power demand.

The unit commitment formulation is characterized by an objective function that is optimized with respect to certain generation constraints. They include: hourly power demand / load, ramp up / down limits, minimum up / down times, maximum and minimum power generated or loading limits, etc.

The paper will focus on dynamic programming method which for years have been employed to solved the Security-Constrained Unit Commitment (SCUC) problem as well as other traditional techniques; adaptive swarm particle optimization, hopfield neural network and augmented lagrangian relaxation method.

The dynamic programming Matlab codes have been modified to obtain an improved version of dynamic programming (IDP), and the effectiveness of the proposed methodology to solve the SCUC problem is demonstrated by comparing the solution of the proposed IDP method to the solution from other methods.

## **An Alternative Method for Sentiment Classification with Expectation Maximization and Priority Aging**

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**Keywords:** Sentiment Classification, Semi-Supervised Learning, Naive Bayes (NB), Expectation and Maximization (EM), Priority Aging

Sentiment classification has been an active research topic in recent years due to its potential impact on semantic based text retrieval. In sentiment classification problem, semi-supervised techniques have become more important due to huge and nonsense unlabeled data in the texts. Since the class labels are manually assigned by experts and the text data are usually difficult to distinguish positive labeled ones from negatives, the unlabeled data points should be labeled before gaining importance. In semi-supervised classification, data are partially labeled and the task is to label the rest of the unlabeled data accurately. In this paper, a novel two-stage semi-supervised learning model for sentiment classification which is based on Expectation Maximization (EM) and priority aging algorithm is proposed. In the proposed approach, the priority degrees are initially assigned to unlabeled data and then the data are labeled due to their priorities by EM. Namely, the most suitable unlabeled data points are joined primarily to the set of labeled data by using the priority aging algorithm. The effectiveness of the proposed approach is demonstrated by using the IMDB dataset. Experiments show that more desired results are obtained by the proposed approach in comparison to conventional EM algorithm.

## **An Aspect Based Sentiment Analysis on Turkish Hotel Reviews**

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**Keywords:** Natural language processing, Aspect based sentiment analysis

The rapid growth in Internet applications on the Web has lead to an enormous amount of costumer reviews for product information. Nowadays, companies prefer utilization of customer feedbacks for evaluating or developing their own brand products .These feedbacks are regarded as the most important factors which assist to increase the quality and competitive power of products which are produced by companies. From now on, customers and companies can easily reach the large number of customer reviews about products via the Internet. Due to such a large amount of document set on the Internet automatic sentiment analysis of online customer reviews has become a hot research topic recently. In this article, a method for automatic sentiment analysis of hotel reviews is proposed. In contrast to most studies that focus on determining only sentiment analysis on document level (positive or negative), the developed method performs a detailed analysis to determine sentiment strength of the reviewer towards various aspects of a given hotel. The main units of the proposed model are: (1) crawling web sites, (2) preprocessing part that involves transforming raw data into an understandable format, (3) aspect extraction from product reviews that have been commented on by customers, (3) determining the sentiment scores of the aspects by a proposed scoring algorithm. The experimental results demonstrated that our model is effective for aspect based sentiment analysis on hotel reviews. By comparing the extracted aspects by our model and the human expert, it is observed that output of our model has more useful aspects.

## A User Friendly CAPTCHA Scheme

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**Keywords:** security ,audio captcha, web expoltation

Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHAs) are becoming popular place on online owing to its performance in preventing automatic exploitation of web services aimed for users. On the other hand, audio CAPTCHAs for users with poor vision are becoming harder for human beings to solve but hackers are getting better at defeating current CAPTCHAs as a result of advances in audio recognition methods and machine learning techniques . In this study , we investigate a variety of well-known audio CAPTCHAs on online to comprehend their robustness and vulnerabilities. After we will develop a new voice CAPTCHA that is intended to be easy for users to pass. Finally, we will test our CAPTHA scheme with some users to improve its usability . The results show that the proposed implementation has high user success rate. Therefore this new system is user friendly and accessible to users.

## Monitoring System for Drivers of Heavy Vehicles

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**Keywords:** Drowsy driving, Vehicle safety system

The health and safety of people on the roads and highways must be taken into measures with high accountability. Cruising drivers may fall asleep or start in feeling the symptoms of a coronary thrombosis (i.e., a possible heart attack). Such situations can lead to irrevocable aftermath. Heavy vehicles (e.g., bus, strongly built cart or wagon for transporting heavy loads) would cause more danger on flow traffic than those of light vehicles. Alcohol and speed are legitimately directed toward the major causes of road accidents, yet another deadly factor is falling asleep at the wheel (usually known as tired driving, drowsy driving, or fatigued driving). Drowsy driving is a major cause of motor vehicle accidents, and it can impair the human brain as much as alcohol can [1]. According to a 1998 survey, 23% of adults have fallen asleep while driving [2]. According to the United States Department of Transportation, male drivers admit to have fallen asleep while driving twice as much as female drivers [3]. In the United States, 250000 drivers fall asleep at the wheel every day, according to the Division of Sleep Medicine at Harvard Medical School and in a national poll by the National Sleep Foundation, 54% of adult drivers said they had driven while drowsy during the past year with 28% saying they had actually fallen asleep while driving. According to the National Highway Traffic Safety Administration, drowsy driving is a factor in more than 100000 crashes, resulting in 1550 deaths and 40000 injuries annually in the USA [4]. A sudden heart attack, in a minor occasion, of a driver of heavy vehicle would cause irreversible consequences as well. However, it is important to prevent life and property from the accidents caused by either alcohol can or speed or drowsy driving or heart attack.

As technology is emerging part and presell of human lives in this century, especially transportation networks are enormously getting be improved. Automobile software technologies are also developing near with transportation networks day by day. Many efforts have been underway for vehicle safety system. For instances, in an effort to make driving safer for both the occupants of the vehicle and their fellow road users, Mercedes-Benz have

been working on a system since 2007 that recognizes tiredness-related changes in personal driving style and warns the driver when it is time to take a break [5]. Toyota introduced a vehicle safety system called driver monitoring system [6,7] in 2006 for Lexus models. The system used infrared sensors to monitor driver attentiveness. Specifically, the driver monitoring system included a CCD camera placed on the steering column which was capable of eye tracking, via infrared LED detectors. If the driver was not paying attention to the road ahead and a dangerous situation was detected, the system should warn the driver by flashing lights, warning sounds. If no action was taken, the vehicle should apply the brakes (a warning alarm should sound followed by a brief automatic application of the braking system). In 2008, the Toyota Crown system went further and can detect if the driver would become sleepy by monitoring the eyelids.

The aim of our effort is to minimize the involuntary loss of life and property caused by the drivers of heavy vehicles. We have proposed an automatic system to provide protection of drivers and travelers by dint of computer vision techniques along with embedded systems and mobile communication methodologies. Sleepy modes detection and then awaken of driver have been controlled with computer vision methods, while mobile communication and car control have been performed by embedded system components. If our system could be adopted in the future, the accidents related to drivers would reduce significantly all over the World.

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## **An Automatic System for Elevator Monitoring**

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**Keywords:** Automatic system, Elevator, Monitoring

An elevator is a conveyor device or transport equipment that moves people or goods between floors or levels or decks of a building, vessel, or other structures. It has become a part and parcel of modern life in developed countries. The number of floors in high buildings, skyscrapers, and towers generate the usage of elevators. If it is simply assumed that each floor has at least two elevators in a thirty-floor building, people call the elevators in each floor even they are already occupied in weight and/or volume. When it is end of the daily work, thousand of homebound people wait at each floor and call the elevator to get out of the building and go their home. However, even the elevator is occupied in weight and volume, elevator stops at each floor in case of calling by the people. This causes people in elevator stop at each floor even their elevator is over-filled by the people. This is known as an annoying problem for the people who use elevators in their daily life. The idea is to control the elevators according to their both weight and volume not to stop them if they are already over-filled in weight and volume. Weight sensors already exist in most of the elevators. But there is no utilization concept of volume sensors in the elevators. Kids wagon can take huge space even their weight is less than the limiting weight of an elevator. Except human being, sometimes some accessories or boxes can be carried by the elevators. If there is no space in the elevator, it should not stop to accept new passengers but it could give a signal to the passengers beforehand that it is unable to elevate new stuffs. Actually, the weight and volume information of elevators can be monitored for the waiting passengers and they can be guided before they call the elevator. Additionally, elevator can be analyzed with a video camera (e.g., Microsoft Kinect) mounted to the ceiling of elevator with a depth sensor next to it.

By dint of video camera and depth sensor integration, we have developed a system that automatically monitors elevator and warns the new passengers about the current status of elevation. The important functionalities of our system include: (a) The threshold for volume constraint is to be parameterized by the system; (b) The system automatically estimates the necessary and sufficient parameters and then makes a decision either the elevator is overfilled in volume or not based on the estimated parameters along with wight; and (c) It warns the passengers if the elevator is overfilled in volume. To work reliably and efficiently, the system examines the following attributes rightfully: (i) Volumetric capacity of the elevator; (i) Amount of occupied volume in the elevator; (iii) Amount of empty volume in the elevator; (iv) Height of the longest object in the elevator; and (v) Height of the shortest object in the elevator.

By installing two cameras opposite to each other, we can monitor the above attributes and estimate the necessary and sufficient parameters by using video information. Based on the predefined volume and weight thresholds of a specific elevator, if either volume or weight will exceed their given thresholds and if the elevator will be called, then the elevator will not stop and give signal that it is unable to elevate new passengers.

# Estimation of Camera Ego-Motion for Real-Time Computer Vision Applications

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**Keywords:** ego-motion, real-time, computer vision applications

The motion in video frames can be divided into global motion and local motion. Motion induced in the video frames due to camera movement is called global motion, whereas small moving objects in the scene result in local motion. If the moving object is large enough to occupy the complete image, it will produce the same effect as camera movement, resulting in global motion in the video frames. The aim of a motion estimation technique is to assign a motion vector (displacement) to each pixel in a video frame. The choice of a motion estimation approach strongly depends on the target of application. A key issue when designing a motion estimation technique is its degree of efficiency with enough accuracy to serve the purpose of intended application. Difficulties in motion estimation arise from unwanted camera motion, occlusion, noise, lack of image texture, and illumination changes.

Camera based computer vision applications e.g., video object detection, human detection, and tracking mostly require stationary camera to avoid false alarms. Camera shaking due to wind or camera movements e.g., zoom in, zoom out, tilt and pan cause errors in computer vision algorithms. At the same time, speed of algorithm is an essential factor for real-time applications. In the literature, there exist various algorithms but they are considered as they are not applicable in real-time applications which require 30 frames per second. Consequently, it is required to develop computationally low-cost and highly efficient algorithms for camera zoom/tilt/pan detection. What is assumed that computer vision algorithms will skip their algorithmic steps in case of zoom/tilt/pan is detected. Henceforth, computationally low-cost and highly accurate zoom/tilt/pan detection algorithm is required for most of the computer vision algorithms.

Our aim is to develop a computationally low-cost and accurate zoom/tilt/pan detection algorithm for real-time computer vision applications. With this end, we have suggested a camera ego-motion estimation algorithm. The algorithm uses a feature based approach for motion estimation. A new method is introduced for feature selection which limits the number of feature points to be tracked and hence lowers the computational complexity. In addition, it has a low dependency on structure in the video frame. For video sequences with unknown motion fields, displaced frame difference was used as the criteria for evaluating the algorithm, whereas vector difference between known and estimated displacements was used as an error measure for video sequences with known motion fields.

Our proposed approach includes the following algorithmic steps: (i) Convert the video frames from RGB scale to gray scale for easier processing; (ii) Apply background subtraction to every frame to extract the foreground objects from the video frame; (iii) Apply frame difference to every consecutive frame to recognize the moving object between frames; (iv)

Compare the pixel location of the moving object obtained from frame differencing with the labels generated now, and find out the label in which they exist; (v) Determine the velocity vectors for the motion occurring in the frame; (vi) Calculate the threshold velocity, the velocity which marks the minimum velocity to be perceived as a gesture; (vii) Segment the object of interest from the frame based on the calculated threshold velocity; (viii) Calculate the area of every segmented object and draw a bounding box around it; (ix) Calculate the center of the bounding box to give the coordinates of the detected motion; (x) Estimate the pan, tilt and zoom of the camera based on the computed coordinates and the range of the camera parameters.

Results show that our proposed algorithm accurately estimates camera ego-motion even for video sequences having small object motion. If there is a big moving object near the image center, the algorithm is sometimes fooled by the object motion and considers it as camera motion. The accuracy of the algorithm for static scenes was quite good, and the achieved reduction in computational cost made the trade off well justified

## Computer Game Controlled by Eye Movements

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**Keywords:** HCI, Pupil detection, Eye gaze

Nowadays people playing games not only for fun, but also is using in terms of education, medicine and researches. For example, video games are taking important role in the development of children. Some 15 years ago every parent was trying to educate their children apart from the school by teaching themselves or buying books for them, but now technology and video games makes it much easier. By playing games children can learn languages, differentiate shapes and colors from the childhood without forcing and having a fun [1]. There is fast development on Human Computer Interface (HCI) technologies for controlling video games. Big companies find very different ways to get user input for better game interactions in earlier days. There are three popular different approaches for this purpose: (i) Analyzing data from accelerometer sensing of hardware; (ii) Speech recognition; and (iii) Analyzing optical input. But most of these approaches require specific hardware. Some of them also requires extra physical effort that users are not used to. Gamer would feel more comfortable if there would exist better tools for gaming.

Eye gaze estimation is the one of the most important HCI tool that is developing against to getting input from keyboard and mouse [2-4]. For eye gaze tracking systems; accuracy, tracking frequency and hardware dependencies are important issues. Since accuracy determines the feasibility of selection of targets such as images and buttons, is used for benchmarking of the eye gaze systems with the speed of the systems [5]. There are various techniques described in literature for eye gaze estimation. Nevertheless, a vast majority of those algorithms require additional special hardware and require manual initialization of pupils. On Witzner's algorithm [6] the iris is modeled as an ellipse, but that technique requires high quality image that is taken very close from user's eye. Some other systems described by Nouredin [7], Park [8] require visuals from two cameras with different angles. Snake algorithm of M. Kass [9] is also used for pupil detection. But it requires improvement on its very low accuracy. Williams [10] proposed an improvement to minimize energy functional of algorithm by using greedy algorithm technique, additional to this method Choi [11] propose

an improved method for segmentation, after Lai [12] used multiple snakes to increase completeness of that method but since none of versions of snakes aren't efficient in case to detect only pupils since those method aren't specifically aims to find circles. Hough Transform method is improved by Marcin and Ingacy [13] to detect circles. In this method, image is first converted to binary image. Then circle equation with different radiuses is applied to every point to detect circles.

Our aim is to develop a computer game controlled by low cost robust eye gaze tracking system and eye gesture detection algorithm by getting visual data from user by a simple webcam. In this paper, we have proposed a game which takes inputs from a video camera, by detecting the direction where user looking to, and detecting eye gestures for click functions. We have used webcam as video input device since it is easily accessible. We have tried to use the eye movements as the HCI (human computer interaction) tool, which would be used instead of a mouse. In general, this provides much easier and fast interaction with computer for everyone including old people, children and disabled people who cannot use mouse. We have also showed that eye tracking and eye gaze estimation can be very easy and fast way to obtain HCI.

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# **New Solution Method for Electrical Systems Represented by Ordinary Differential Equation**

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**Keywords:** Signal and Systems processing, Bigeometric Calculus, Bigeometric Runge Kutta, Ordinary differential equation, Runge-Kutta, Caotic circuit.

Electrical circuits based on linear and nonlinear modelling principles have difficulties to meet demands caused by a large amount of data generated and processed. The aim is to examine the existing models from bigeometric calculus point of view to obtain accuracy on the results. This work is an application of bigeometric Runge Kutta method aiming to solve differential equations with nonzero initial condition. This type of work arises from applications where the system represented by ordinary differential equations such as noise, filter, audio, caotic circuits e.t.c. Solutions to these type of equations are not always easy. The improvement in this work obtained by introducing bigeometric calculus in the process of seeking a solution to differential equations. Different class of input signals applied as input to the system and processed to determine the accuracy of the output. The applicability tested against the classical method called Runge-Kutta(RK4). Simulation results confirm the application of Bigeometric Runge-Kutta method in electrical circuit analysis. The new method also provides better results for all type of input signals, i.e., linear, nonlinear, constant or Gaussian.

## A Modified Quadratic Lorenz Attractor

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**Keywords:** Dynamic systems, Chaos, Lyapunov exponents

Dynamical systems are mathematical models describing the evolution of systems in terms of equation of motion with sensitive initial values. The Lorenz system is a system of ordinary differential equations first studied by Edward Lorenz. It is notable for having chaotic solutions for certain parameter values and initial conditions. In particular, the Lorenz attractor is a set of chaotic solutions of the Lorenz system which, when plotted, resemble a butterfly. Many chaotic systems exhibiting a similar simple structure as the Lorenz system, without being topologically equivalent, are proposed during the time. In this study a new modified quadratic Lorenz attractor is introduced. The properties of the new chaotic system are analysed and discussed in detail, by determining the equilibrium points, eigenvalues and the Lyapunov exponents. The numerical simulations, time series analysis, and the projections to the xy-plane, xz-plane, and yz-plane are conducted to highlight the chaotic behaviour. Then the multiplicative counterpart of the new system is also presented and the simulations are conducted using the multiplicative Runge-Kutta methods.

# **The Bigeometric Taylor Theorem and its Application to the Bigeometric Runge Kutta Method**

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**Keywords:** Bigeometric calculus, Runge-Kutta, Ordinary Differential Equations

Every problem has its own characteristics and properties, so evidently there is also a significant number of problems in Science and Engineering. Therefore, one can design a tailor-made Calculus with the desired properties for any problem. Grossmann and Katz proved that it is possible to produce infinitely many calculi independently. They build a big family named Non-Newtonian Calculus, covering also the Newtonian or Leibnizian Calculus, the Geometric Multiplicative Calculus, the Bigeometric Calculus. In many studies based on Bigeometric Calculus, an approximation to the Bigeometric Taylor series is used without knowing the correct version. In this study, we have stated and proven the differentiation rules for the Bigeometric derivative explicitly, and derived the Bigeometric Taylor theorem on the basis of the geometric multiplicative Taylor theorem exploiting the relation between the geometric and Bigeometric multiplicative derivative. As an application of the Bigeometric Taylor expansion, we derived the Bigeometric Runge Kutta Method. The Bigeometric Runge-Kutta method is applied to problems with known closed form solutions to show the superiority of this method for a certain family of problems compared to the one in Newtonian calculus. Furthermore, the Bigeometric Runge-Kutta method is tested on for the mathematical model of Agarwal for the Tumor Thereapy with Oncologic Virus and the Bigeometric Rössler attractor, showing the general applicability of the method.

## Consumer Behaviour Analysis using Analytic Hierarchy Process

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**Keywords:** Analytic Hierarchy Process, Hierarchy, Decision Making, Behaviour Analysis

In last decade, increase in number of shopping centers in North Cyprus, incited companies about investigating customer behaviors. Examining results of provided services and campaigns, provides a valuable resource for behaviour analysis. In order to get fruitful benefits from analysis, usage of trusted and approved methods is indispensable. Analytic Hierarchy Process (AHP) is a valuable tool for evaluating consumer behaviour in shopping centers.

AHP provides a structured approach for solution of complex decision making problems with its easily applicable mathematical formulation and flexible structure. In almost all decision making tasks that can be faced in real life applications AHP can give us a reliable solution. Basic principle of AHP depends on ranking priorities of criteria affecting choice of an alternative amongst several alternatives. All criteria and sub-criteria are located in a hierarchy tree to obtain a structured solution. Any decision making operation which has multiple quantifiable criteria that can be ordered in a hierarchy, can be carried out with AHP.

All common or alike services provided by different companies are determined and ranked for each company separately. While ranking, each service is compared with others with respect to customer satisfaction. Customer satisfaction data is obtained with questionnaires asking questions about presented services. Results of surveys are located in an AHP tree as factors and services are located as options. By this way, most preferred service is determined. Examination of companies for most preferred service provides a valuable information about consumer behavior on different regions of North Cyprus. Also, determination of common behaviours provides a very useful information for companies about providing services which can be classified as essential.

## **Modular Robotic Arm**

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**Keywords:** Robot, Robotic Arm, Modular, Industry

Industrial robots are started to be designed in 1937. Since that date a lot of technological improvement are recorded about robots. Nowadays its not possible to establish an industrial production line without them. Their widespread usage in industry, keeps importance and popularity of robots in a considerable level. Because of growing demand on market, robotic studies took a part in engineering education. The aim of these studies is to improve mechanical, electrical and computational capabilities of robots. Researches on mechanical side are carried about movement capability and durability, on electrical side about power consumption, precision and process speed, and on computational side about artificial intelligence, friendly usage and multipurpose application.

In this paper a modular robotic arm project is presented. Developed arm can be used in educational purposes because of its modular form and wide usability options. It is possible to control arm via buttons on it, with a program loaded to its internal memory and integrated microcontroller or using a PC connected to it. It also enables us to replace hand part of the arm with a new design. Because of its modularity, it is possible to redesign arm for any desired specific task by modifying its mechanical and electrical components, and changing its program.

# **An Anthropometric Approach to Computer Usage in University Studies: A Case Study of North Cyprus Universities**

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**Keywords:** anthropometrics, university, ergonomics, TRNC, statistics.

In today's world, the use of computers is a necessity for a lot of people from all spheres of life and different parts of the world. For an increasing number of students from around the world, they have to make use of the computer as an integral component of their study. However, not many people are actually aware or consider the medical consequences that working with computers can cause, e.g. damaged eyesight, bad posture, arthritis in fingers and computer stress injuries that can be caused by sitting in one position or adopting a posture for a prolonged period of time. In recent years, research has shown that prolonged continuous computer usage has been identified as a risk factor for the development of musculoskeletal problems, which may lead to a decrease in work performance of users. University students who perform intensive computer tasks are at risk for developing pain and musculoskeletal disorders at the wrist, forearm, back, neck etc.

In the Turkish Republic of Northern Cyprus (TRNC), the prevalence increases with age, and reaches a peak when the individuals become sixty years old and above. However, to a large extent, the prevalence of low back pain, neck pains etc. stems from the activities and lifestyle the individual may have been exposed to as a child. Therefore, to fully understand the distribution and occurrence of low back pain and other pains in the body, as well as what exposes someone to low back pain in adult life, it is imperative to study the situation at a young age.

In TRNC universities, students are exposed to the use of computers for their daily school activities and social networking. Most of the students in these departments operate their computer in a workstation that makes them prone to maintaining poor posture for a long period of time which may lead to musculoskeletal dysfunction.

A self-determined questionnaire is prepared to collect data regarding the musculoskeletal problems caused by excessive computer usage. The questionnaire has been applied to 555 students who are studying in Northern Cyprus universities.

After the analysis of the collected data, postural and musculoskeletal problems caused by computer usage are identified. As a result of the analysis of the collected data, and the anthropometric measurements of a sample set of students, a new computer workstation design for usage of personal computers and laptops is suggested.

## Signal Analysis of Optical Circuit Elements

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**Keywords:** Communication technologies, optical communications, optical directional coupler, optical fiber sensor, optical amplifier

In this study, some optical circuit elements of optical communication systems, such as optical directional coupler, optical fiber sensor and optical amplifier are analyzed.

First, the coupling of optical directional couplers, which consist of planar, slab, weakly guiding, lossless and bare optical fibers, is solved with Coupled Mode Theory where a modal analysis problem is considered and coupling coefficients are determined. It is shown that, in modal coupling of optical fibers, maximum coupling occurs for the synchronized case. It is shown that the coupling between TE modes is bigger than that between TM modes. Furthermore, it is observed that the coupling between TE even modes is more effective than that between the other modes.

Second, optical sensors are considered. In designing Mach-Zender interferometric sensors by utilizing Elasticity Theory, in order to increase the sensitivity, the parameters should be suitably selected to achieve higher phase change. It is found that, for a given wavelength, the phase change increases as the tensional elasticity modulus, Young modulus, is increased. Furthermore, it is found that, for a given refractive index or diameter, the phase change increases as the Poisson ratio, is increased.

Third, one way, erbium doped, fiber amplifiers (EDFA) are analyzed. In the application, 10 m long erbium doped optical fiber is fed by coupling a source which sends a signal at a single wavelength, with a pump laser of 150 mW power and 1480 nm wavelength at 25 °C temperature. The gain of the system is measured with a gauge. For this circuit element, it is observed that the gain in the third window region is high.

# Optical Communication Techniques and Applications in Railway Transportation Systems

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**Keywords:** Railway transportation systems, communication technologies, optical communications, optical fibers, wavelength division multiplexing, pulse code modulation

Today's progressive living conditions are increasing the need for broader resources and proper media and tools in the communications technologies. In order to fulfil the ever increasing demand for speed and capacity, usage of broad-band communications systems is required.

Optical communications systems, whose literature consists of articles on the analyses of both the communications systems mechanisms where the optical network elements such as optical sensors, couplers, modulators, oscillators, circulators, polarisers, isolators, amplifiers, detectors and filters are studied, and the physics of electromagnetic wave propagation in optical waveguides, are at the key position of the progress in communication technologies today. Many branches of today's industries utilize optical communication technologies which possess absolute superiority as compared to the other cable communication systems as well as wireless communication systems. Today, optical communications systems are commonly used in transmitting data, telephone networks, various medical and military applications as well as in land, sea and air transportation vehicles. Railway vehicles are among the ground transportation vehicles which benefit from today's sophisticated optical communications technologies.

In this study, signalling in railway transportation systems are considered and historical development of their working mechanism is investigated. The applications and structures of the communications systems in railway transportation industry where high speed communications are essential for safety are assessed, within the framework of the broad band and high data transmission rates of optical fibers due to their operation in THz level. In this study, an optical communication system, where temperature, pressure, air condition, door sensor, emergency switch and routing signals reach a central control unit after passing through the converters of the wavelength division multiplexing system, WDM, and elements where pulse code modulation, PCM, is applied, is analysed. Characteristic properties of optical network elements and optical fiber media of the optical communication systems, which enable a railway vehicle operator's access to the current status of various systems of the vehicle in real time, if we neglect the time delay due to system components, which occur even for a system consisting of ideal elements, and his intervention in case of emergency, are determined.

## Lossless Compression Based on Transition

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Since 1970s data compression started to play a significant role in computing. It is possible to categorize compression algorithms in two major branches as lossy and lossless. Lossless compression simply reduces size of data by enabling restore of exact original data without data loss. In the literature, there are many text compression algorithms which takes place in lossless category. Classically lossless data compression is carried out using statistical redundancy based on repetition. From that point on, almost all of these algorithms depend on the number of repetition of each character in the text. In this study, a new method is proposed which mainly rely on the number of transitions from one character to another one. The test bed includes 10 Turkish texts of approximately 2 Kbytes each. The experimental results have shown that the new proposed method for text compression is an effective method when compared with classical methods. Furthermore, it can easily be improved by iteratively performing the same steps for the compressed text.

# Optimum Design of Vehicle Parts Using Simulation Based Approaches and Approximation Techniques

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**Keywords:** Heuristic methods, Design of Experiments, Optimum design

Today's companies are facing fierce competition which is forcing them more than ever to consider different approaches to solve the complex design optimization problems in shorter lead times with reduced computational cost and to improve quality and to reduce costs. In recent years, there is a growing interest to use simulation based approaches and approximation and artificial intelligent techniques to handle complex design optimization problems whit non-linear characteristics and large solution space. They can help designers in evaluating possible design solutions and design alternatives during the early stages of design. They are utilised as being initial design tools to obtain the initial solutions by reducing the computational cost of complex design optimization problems in shorter lead times. Approximation, heuristic optimization and artificial intelligence techniques are widely used to solve these kinds of problems since analytical gradients in simulation-based optimisation methods are difficult to obtain or even not available, due to the high non-linearity of the design problems such as crashworthiness design and impact problems, the responses are often noisy and it is hard to find the gradients. Direct optimisation methods without approximations or heuristic techniques are not applicable due to the large number of function evaluations they required. Therefore, a different approach is necessary. Approximation methods will overcome

these kinds of problems, especially in case of dynamic design optimisation problems. The computation time required for structural analysis is a major obstacle in structural optimisation studies. Approximation methods, therefore, are key technologies for industry acceptance of structural optimisation. One of those approximation methods is the response surface methodology (RSM). In this paper, these techniques with response surface methodology are presented to solve complex design optimization problems early in the design stage in automotive industry. In this paper, these techniques are briefly introduced and a case study to illustrate how these techniques provide an efficient tool for complex design optimization problems is presented for optimum design.

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